Space Exploration and International Cooperation
The George Washington University
Washington D.C
June 21, 2004

John Marburger
Director, Office of Science and Technology Policy
Executive Office of the President

Thank you for inviting me to speak in this symposium. "Space Exploration" is a phrase that has come to symbolize many different things, and one of my objectives today is to sort out these meanings and provide a framework for understanding how to approach diverse space issues. It is clear enough, however, that "space" is *territory*, and largely unexplored. Furthermore, the part of space that is physically accessible to us in the foreseeable future is uninhabited, except by the human race. We are, in a sense, its stewards. And so we inherit a collective responsibility, an international responsibility, for its development.

The best analogy to the role space plays in the broad context of human history is Antarctica. Like other regions of the globe remote from the center of civilization, Antarctica emerged into history as a target for heroic expeditions of discovery. The first ventures were primitive in their intent: simply to see what is there, to plant a flag, to be the first. The region was mapped, its physical features probed and analyzed. With growing knowledge of ocean and atmospheric science, Antarctica's significance for the world's environment and marine resources became clear. With time, its value as a site for science drew an increasing diversity of operations: from observations of the ozone hole, to studies of ancient climates, to neutrino telescopy. Nations convened and agreed on conditions for working together in this forbidding region, and today it is the site of more or less permanent facilities supporting a wide array of activities our governments have found worthwhile. The history of Antarctica is one of transition from heroic expeditions to routine, but still demanding, operations in pursuit of diverse objectives. On January 14, President Bush unveiled a vision for space exploration that begins a similar transition for the part of our physical environment that lies beyond Earth's surface.

Unlike Antarctica, the space environment had been observed with telescopes for centuries before humans developed the means for traveling there. Those observations, which continue today, are a form of space exploration that remains supremely important. They are the only form of exploration foreseeable for territory beyond the solar system. And this form of exploration had its heros too, most famously Galileo, the telescopic counterpart of Neil Armstrong. His discoveries of the surface of the moon, sunspots, and the moons of Jupiter caused a stir comparable in its time to the first lunar landing.

When Neil Armstrong first stepped onto the moon in 1969 he achieved, on behalf of all humankind, a conquering objective similar to the expedition of Amundsen to the South Pole little more than a half century earlier. At that time, at least in the popular imagination, it seemed that space had somehow been conquered. That is an illusion, of course. Much, much more remained to be done to make even a tiny fraction of this immense territory available for human use.

Today we know much more about the difficulties of space exploration by humans or machines, and our thinking about space has evolved with our growing awareness of its costs and hazards. If we truly want to make space part of the human domain, then we are going to have to have a sustained approach radically different from the singular effort of the Apollo program.

President Bush has framed such a transition in the aims of space exploration that is at once visionary and pragmatic. "In preparation for future human exploration," he said, "we must advance our ability to live and work safely in space and, at the same time, develop the technologies to extend humanity's reach to the Moon, Mars, and beyond." This is a vision of enabling, of going beyond heroic expeditions.

The President's vision for space exploration is that of "a journey, not a race," a concept that differs profoundly from the Apollo paradigm of a single massive project requiring a large budget spike and a demanding schedule. The new vision calls for an affordable and long term sustainable effort to achieve access to space, and in the President's words: "…extend the human presence across our solar system, making steady progress one mission, one voyage, one landing at a time." The President envisions that eventually humans will incorporate accessible space into their zone of routine activity. That entails the long term build up of capabilities – of infrastructure extending out from Earth – that lowers the cost and risk for all space missions.

The vision specifically calls for the United States to pursue international cooperation and commercial opportunities to further these objectives. International cooperation does not mean simply avoiding duplication of effort. It means enhancing the effectiveness of each nation's contribution to the future use of space. It means sharing risks as well as resources – technical as well as financial – and reducing the costs of exploration for all partners.

The U.S. is investing in a wide range of science and technology expected to support our efforts in space. We will continue to invest in R&D, cooperate with our international partners, and take advantage of capabilities in the private sector, "harvesting" technologies as they mature. In this new vision, milestones are established to guide planning on a series of discrete and mutually reinforcing technical projects, whose aim at each step is to reduce the cost and the risk of subsequent missions.

To sustain this process over the long term, and eventually make space a part of our economic life, requires innovation not only in technologies, but in how we do business. Not only do we need better end products; we also need better processes for getting them, and we need to search globally for partnerships to help achieve our objectives.

We view international cooperation not as an end, but a means. Reliable mechanisms must be established to assure long-term commitment to projects. Innovative ways need to be found to distribute costs and benefits equitably. Intellectual property, technology transfer, and issues of international security all need to be addressed. The efficient management of international partnerships is a complex activity that must be approached deliberately using professional best practices and a good deal of diplomacy.

The Cassini/Huygens mission to Saturn, soon to be consummated, provides a good example of successful international cooperation. This is the most complex interplanetary spacecraft ever built, and it was done with international partners: NASA, the European Space

Agency and the Italian space agency ASI (Agenzia Spaziale Italiana), and several separate European academic and industrial contributors. Through the mission, approximately 260 scientists from 17 countries hope to gain a better understanding of Saturn, its stunning rings, its magnetosphere, Titan, and its other moons.

The Aldridge Commission – the special group established by the President to advise on carrying out his vision – found in their recent report that international technologies and talents would add significantly to the successful implementation of the broader space exploration activities, and that tapping into the international marketplace is consistent with the aim of using private sector resources to meet mission goals.

The Commission identified two approaches for international cooperation, one based on pooling resources and maintaining clean divisions in systems, tasks and responsibilities. The other approach requires a higher level of collaboration and mutual understanding, but also promises a greater benefit. It is an integrated approach, where the overall goal is clearly defined, and participants provide components on a best-value basis. It depends on a single system integrator that takes into account the overall goal, as well as cost, schedule, performance and risk. This is the model of the Joint Strike Fighter program. The U.S., Britain, Italy, Holland, Turkey, Australia, Denmark and Norway contribute to the program directly, and participate in aspects of the program management in accordance with specific agreements that also cover security, export control, and technology transfer. At the same time, there are no offset agreements and no guarantee that any one will recoup their investment.

This Joint Strike Fighter model is not confined to pooling resources. It includes joint planning responsibilities and shared expertise, playing to each country's economic and technological strengths. The President and the Aldridge Commission both recognize that continued space exploration beyond earth orbit will require development of a series of critical technologies that will not necessarily be found in just one country, not exclusively within government, nor only within industry, nor singularly at home or abroad. The capabilities will need to be harvested on a global basis.

Finally, international cooperation cultivates a sense of global purpose, and raises the visibility of issues of worldwide importance. This is a lesson of cooperation that we have learned before in connection with science projects of global significance. The need to pursue international partnerships is strongly motivated by the changing nature of the world science agenda. This is especially true in environmental research, where scientists are embarking on complex, long-term studies of the global ecosystem in connection with challenges presented by global climate change and evolving land-use. But it is also true in fundamental science where questions of the nature of matter and the history of the universe increasingly require huge apparatus, too expensive for any one nation to justify, but important for the human quest for knowledge.

The President's space vision acknowledges the importance of this quest, but it also demands that we consider seriously what is required to pursue it. Further heroic expeditions may yet be in our future, but the ultimate objective is much grander – to make the forbidding territory of space an asset for all humankind. It is a vision that can only be accomplished with the partnership of nations.